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THE EFFECT OF SERVICE INFLUENCE FACTORS ON PERCEIVED USEFULNESS AND USE SATISFACTION IN DIGITAL HEALTHCARE SECTOR

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ABSTRACT

The convergence of advanced technologies such as AI, IoT, and BigData with medical technology also has changed medical services significantly. Particularly digital healthcare services have developed in the untact settings by the COVID-19 pandemic. This study aims to examine factors that affect the usefulness of such digital health care services perceived by users and their use satisfaction. The study defines the 'personal influence factor, 'information quality factor,' and 'social impact factor' that affect digital healthcare service use and empirically analyzes the effects of such factors on perceived usefulness and use satisfaction. A survey was conducted among 364 individuals who used digital healthcare services in Korea, and then statistical analysis results were derived. Hence analysis results show that personal influence factors and social impact factors positively affected perceived usefulness while information quality factors did not. In addition, it turned out that personal influence factors and information quality factors had positive effects on use satisfaction while social impact factors did not affect use satisfaction. The above-stated results suggest that when it comes to digital healthcare service, personal influence factors concerning the experience of product or service use affected perceived usefulness and use satisfaction, social impact factors affected perceived usefulness, and information quality factors affected use satisfaction to a significant degree.

Key words: digital healthcare service, personal influence, information quality, social impact, perceived usefulness, use satisfaction

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1. INTRODUCTION

As ICT develops recently, medical services aiming to improve human life quality and prevent sickness or disease are changing significantly. Particularly in digital healthcare services, people's interest is increasing rapidly. The recent healthcare trend is comprehensive health management service, which is a smart healthcare service emphasizing personalized, predictive, preventive, and participatory elements in line with Information Technology (IT) and Bio-Technology (BT) advancement, while traditional medical services focused on treatment at medical centers [1]. In other words, digital healthcare service is a comprehensive type of service to measure individuals' health status by means of smart devices and smart home methods [2].

Notably, digital healthcare service utilizing smart devices needs to provide users with professional health information and provide medical practitioners and related groups with education and training programs to apply IT as part of public medical service. In addition, the comprehensive advantages of e-commerce need to be secured and provided in healthcare [3]. For users carrying a smart device, digital healthcare service needs to take advantage of basic health information and e-commerce, as well as education/training programs for medical practitioners.

In general, digital services reflect personal needs and feature such advantageous factors as ease of use, usefulness in technology acceptance, and convenience. However, social factors are also affected in digital healthcare services since social supply networks and welfare systems may be involved in clinical and health management as part of medical service [4]. Most previous studies on digital healthcare services empirically examine the use and acceptance of technology and information literacy, particularly among older people, whereas many studies also focus on personal motives of using digital service and their acceptance of technology. In contrast, there has been little research on social factors in this area.

Accordingly, this study broadens the scope of factors that affect digital healthcare services to cover social factors and customization and information quality to empirically examine the effects of such factors on perceived usefulness and satisfaction. To this end, this study defines personal influence factors such as health concern, self-efficacy, and personal innovation. As for information quality factors, information quality, information reliability, and information availability are defined. As for social impact factors, social capital, social support, and social value are defined. In addition, a study model was designed to analyze the relation between digital healthcare service and users' perceived usefulness and use satisfaction. Specifically, this relation must be clarified to understand the factors that affect users' perceived usefulness and satisfaction with digital healthcare services.

2. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

2.1. Digital Healthcare Service Influence Factors

A group of factors that are regarded as most important among factors affecting customers who use digital healthcare services is personal influence factors that motivate individuals to start using or continue to use the service. Personal influence factors include health concerns, self-efficacy, and personal innovation. Health concern means that users show interest in health behaviors and preventive health behaviors as part of their lives [5]. People with high health concerns pursue health information, show positive attitudes toward preventive health behaviors such as exercise and diet, and actively participate in local health issues [6]. After all, people with high health concerns are likely to show positive attitudes toward health behaviors to prevent health problems and participate in local activities.

Health self-efficacy means the extent of one's self-confidence on the health management ability to fulfill preventive health activities successfully and control one's motivation, thinking

process, emotional state, and behavior patterns, among others [7]. In other words, this concept defines one's expectation of the achievement that results from a given behavior. It can affect every behavior element, such as efforts to act against an imminent dangerous behavior to achieve one's goal or the desire to overcome hindrances [8]. On the assumption that when someone does not expect to practice a particular behavior successfully, he or she will not take that action [9], and self-efficacy affects a user's perceived usefulness and ease of use [10][11]. In addition, self-efficacy is applied to digital healthcare: A user with self-efficacy regarding mobile healthcare service perceives such service as valuable and easy to use, according to a previous study [12].

Personal innovation means taking the initiative among members in the system where a specific individual belongs [13]. Innovation is defined as an idea, practice, or object that a particular individual or another accepting subject recognizes as new [14]. Personal innovation is defined as an individual's voluntary determination to try a new IT [11]. One previous study [15] suggests that in healthcare, user innovation significantly affects usefulness, ease of use, and use intention of e-commerce. Another study states that a user's tendency to innovation indirectly affects the continued use of a smart watch [16].

As for information quality factors, not merely attributes of a product but the level of information quality significantly affects the use of digital information since digital healthcare service is used based on digital products and information. In terms of information access for health and medical treatment, information reliability and accuracy can affect consumers' perceived value and satisfaction quite significantly. As this is an evaluation of the products of an information system, the focus is on evaluating the value of the information provided. Components of information quality, such as accuracy, timeliness, and stability, need to be considered [17].

In general, the information quality is recognized as high when the user feels as if the information satisfies certain standards, including accuracy, timeliness, appropriateness, and comprehensiveness [18] [19]. As for information quality, the information provided to service users is related to health in healthcare. If the information quality is low, the user may conduct or manage inappropriate healthcare activity, which is likely to cause physical and mental damage to the user [20]. In digital healthcare services, it is possible to provide users with information for a healthy life in an easy and fast manner using digital features [21]. Information reliability may be defined as the trust that one's identity information and health information will be kept confidential and that information will be utilized only with one's prior consent. The hypothesis that the intention of use and perceived usefulness vary depending on the level of information leakage risks was verified in a study on the intention of using online payment services. It turned out that the risk of information leakage decreased the level of perceived usefulness and use intention [22].

Social impact include social capital, social support, and social value. Social capital means social resources obtainable through various interpersonal relations [23]. The entire set of resources exists concerning social desires, obligations, expectations, structural relations, and information flows and circulations based on social networks, mutual perception, recognition, friendship, and trust [24]. Social value is defined as comprehending a wide range of concepts such as the value of belonging to an organization, identity, social distinction, freedom, unity, trust, tolerance, responsibility, love, and friendship [25].

Social support means all of the positive resources an individual may obtain in interpersonal relations [26]. It is assumed that there are the following supports: evaluative support to make one feel that he/she is valuable and respected; emotional support to make one feel that he/she is cared for and loved; informational support to make one feel that he/she belongs to a social

network as its member who can communicate with one another and bears mutual obligations [27][28]. Among these, the appropriate role is informational support to make one feel that he/she belongs to a social network as its member who can communicate with one another and bears mutual obligations [29].

2.2. Perceived Usefulness and Use Satisfaction

Personal, information quality, and social factors will affect users' perceived usefulness and satisfaction with digital healthcare services. As to perceived usefulness, certain beliefs that affect the decision to accept a new technology product or service are explained with perceived usefulness and ease of use. It is also explained that these two beliefs determine a user's attitudes toward the innovative technology or product and affects use intention [30]. Perceived usefulness means that users regard using a particular IT system as not complex [31].

In this regard, the Technology Acceptance Model (TAM) explains the intention of accepting innovative technologies such as a computer (IT) based on the Theory of Reasoned Action (TRA) suggested by Fishbein in 1975. The health concern is known to be a factor that determines health behaviors. A person of high health concern tends to constantly care for one's health through health-oriented activities such as regular exercise compared to a person less interested in health [32]. In addition, even people in the same age group may practice health behaviors such as using fitness bands more actively than others, depending on the degree of health concern [33].

Accordingly, this study considers the following hypotheses regarding the effect of digital healthcare service, personal influence factors, information quality factors, and social impact factors on users' perceived usefulness;

Hypothesis 1. *Personal influence of digital healthcare services may affect perceived usefulness positively (+).*

Hypothesis 2. *Information quality of digital healthcare services may affect perceived usefulness positively (+).*

Hypothesis 3. *Social influence of digital healthcare services may affect perceived usefulness positively (+).*

Use satisfaction is analyzed to assume that the system is successful if the person using the system is satisfied. Particularly in information systems, this is often used as an alternative variable that indicates whether an information system is successful, in addition to such factors as system performance and effectiveness [34]. Furthermore, use satisfaction is related to the completeness of information quality, ease of use, personalization, relevance, and security [35]. Cho [36] analyzed the effect of confidence in the technology on perceived usefulness, ease of use, use satisfaction, and continued use intention.

Pérez-Fuentes et al. [37] demonstrated that customers' level of self-efficacy affected use satisfaction. Personal innovation means that one individual intends to accept a new technology earlier than other social members based on new acceptance factors [13]. Balapour [38] defines use satisfaction as an index of how the quality of system characteristics (information, system, cooperation, service) helps users. Cohen and Hoberman [39] stated that social support means all positive resources a person can obtain from interpersonal relations. Accordingly, this study considers the following hypotheses regarding the effect of digital healthcare service, personal influence factors, information quality factors, and social impact factors on use satisfaction;

Hypothesis 4. *Personal influence of digital healthcare service may affect use satisfaction positively (+).*

Hypothesis 5. *Information quality of digital healthcare service may affect use satisfaction positively (+).*

Hypothesis 6. *Social influence of digital healthcare service may affect use satisfaction positively (+).*

Perceived usefulness could be an essential factor in predicting the satisfaction of service users. Consumers value a service based on perceived evaluation results, recognize emotional responses, and determine follow-up behaviors accordingly. Many previous studies support the finding that the perceived value affects customer satisfaction [40]. Raza et al. [41] verified that functional and symbolic values positively affected users' satisfaction and intention to revisit. Lai [42] also suggested that users' perceived value affected customer satisfaction significantly. Accordingly, this study examines the following hypothesis that perceived usefulness would affect use satisfaction;

Hypothesis 7. *Perceived usefulness of digital healthcare service may affect use satisfaction positively (+).*

3. RESEARCH METHOD

3.1. Research Model

This study defines the 'personal influence,' 'information quality,' and 'social impact' that affect digital healthcare service use and empirically analyzes the effects of such factors on perceived usefulness and use satisfaction. Regarding this relation, the study model in Figure 1 below was designed in line with the hypothesis based on previous studies;

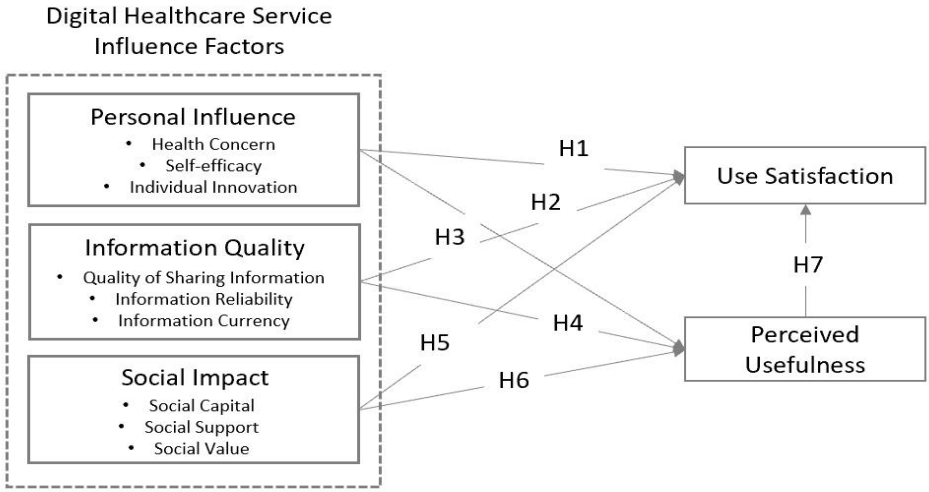

Figure 1 Research Model

3.2. Measurement Variable and Data Collection

A survey was conducted for data collection to analyze the model stated above. Survey items listed in Table 1 were selected based on previous studies, and manipulative variables of these survey components were defined. As to the manipulative definition of variables used in the survey, 'personal influence' of digital healthcare service stated in this study mean personal

health concern, self-efficacy, and personal innovation that affect a selection or use of digital healthcare service. 'Information quality' means shared information's quality, information reliability, and information availability that are related to the selection or use of digital healthcare services. 'Social impact' means social capital, social support, and social value factors that affect the selection and use of digital healthcare services. Among dependent variables affected by such factors, 'perceived usefulness' means the value level of effectiveness users perceive digital healthcare service. Finally, 'user satisfaction' indicates the level of satisfaction and intention of continued use among users who experienced digital healthcare service.

Such defined variables were reflected in 35 questions of this survey as follows: As to personal influence, 4 questions about health concern and 3 questions about self-efficacy and personal innovation were designed based on the following previous studies: Dutta-Bergman [5], Schwarzer and Fuch [8], and Venkatraman and Price [10]. As to information quality, 3 questions were designed regarding shared information quality, information reliability, and information availability, respectively, based on the previous study of DeLone and McLean [34]. As to social impact, 3 questions regarding social capital, 3 questions regarding the social value, and 4 questions regarding social support were designed based on the following previous studies: Delone and McLean [43], Bandura [44], and Klamer [25]. Three questions regarding perceived usefulness were designed based on Venkatesh and Davis [10], and 3 questions regarding use satisfaction were designed based on the previous study of DeLone and McLean [34].

Table 1 Variable Definitions

Factors	Variable Definition	References
Personal influence	Personal health concern, self-efficacy, and personal innovation that affect the selection or use of digital healthcare service	Dutta-Bergman [5], Schwarzer and Fuch (1995), Venkatraman and Price [10]
Information quality	Shared information's quality, information reliability, and information availability are related to selecting or using digital healthcare services	DeLone and McLean [34]
Social impact	Social capital, social support, and social value factors affect the selection and use of digital healthcare services	Delone and McLean [43], Bandura [44], Klamer [25]
Perceived usefulness	Value level of effectiveness that users perceive regarding digital healthcare service	Venkatesh and Davis [10]
Use satisfaction	The level of satisfaction and intention of continued use among users who experienced digital healthcare service	DeLone and McLean [34]

3.3. Demographic Information of the Data

The online survey was conducted through random sampling among common citizens in their 20s to 60s. Survey participants resided in 7 regions (Seoul, Gyeonggi-do, Chungcheong-do, Gyeongsang-do, Jeolla-do, Gangwon-do, and Jeju) and had experience using digital healthcare services. The survey was conducted for 36 days, from August 15 to September 20, 2020. Four hundred copies of the questionnaire were collected. Thirty-six copies with incomplete answers were excluded, and the rest, 364 copies, were used in the final analysis. Among survey respondents, men were 51.6%, and women were 48.4%. Regarding age, those in their 10s were 19.8%, 30s 23.9%, 40s 25.8%, and 50s 30.5% respectively. Professionals were 14.6%, students 9.6%, and self-employed 8.0%. As for academic backgrounds, 72.2% were college graduates, while 16.5% completed a graduate school course. Most subjects were highly educated. As to the period of using digital healthcare service, the largest portion (44%) used it for 1 to 3 years.

32.4% used it for 3-5 years, and 11.8% used it for 5-10 years. Most of the respondents used digital healthcare services for at least 1 year. Regarding the reason for use, 67% used it for health management, 26.7% for life rhythm management, and 4.7% for disease management. Thus, it turned out that most of the respondents used digital healthcare services for health management (see Table 2).

Table 2 Demographic Information of Survey Participants

Classification		Frequency	Percentage (%)
Sex	Male	188	51.6
	Female	176	48.4
Total		364	100
Age	20-29	72	19.8
	30-39	87	23.9
	40-49	94	25.8
	50-59	111	30.5
Total		364	100
Vocation	Office work	187	51.3
	Production	16	4.4
	Student	35	9.6
	Public officer	4	1.1
	Professional	53	14.6
	Self-employed	29	8.0
	Etc. (jobless)	40	11.0
Total		364	100
Academic background	High school graduate or lower	34	9.3
	College graduate	270	74.2
	Graduate school or higher	60	16.5
Total		364	100
Digital healthcare Period of service use	Less than 1 year	37	10.2
	1-3 years	196	44.0
	3-5 years	118	32.4
	5-10 years	43	11.8
	Longer than 10 years	6	1.6
Total		364	100
Digital healthcare Reason of service use	Health management	280	67.0
	Disease management	17	4.7
	Life rhythm (condition) management	97	26.7
	Etc.	6	1.6
Total		364	100

4. RESULTS

4.1. Analysis Results of Reliability and Validity

As shown in Table 3, it turned out that the reliability and validity of the measurement models were all satisfactory. To analyze the reliability and validity of the structural equation model, the composite reliability index was measured: As the index was 0.7 or higher, it was viewed that the proper level of internal consistency reliability was secured. Convergent validity was

assessed based on factor loading, Cronbach α, and the composite reliability index. If the factor loading was 0.5, Cronbach α = 0.6, and the value was statistically significant, it was viewed that convergent validity was secured.

Because of these criteria, the range of factor loading was 0.602 to 0.989 (all over 0.5). As to internal reliability, the range of composite reliability was 0.765 to 0.929. Thus, the significance was secured. Since the value of t was at least 6.5, it was statistically significant. The average sampling variance (AVE) value was between 0.511 and 0.735, and Cronbach α was between 0.693 and 0.825. Hence, the proper level of composite validity was secured. And it turned out that the AVE square root value of each latent variable was significant (see Table 4). As the fitness of the measurement model was analyzed, χ^2(df) was 148.900, and χ^2/degree of freedom was 2.327. The value of Goodness-of-Fit-Index (GFI) was 0.942, that of Adjusted Goodness-of-Fit-Index (AGFI) 0.871, that of Normal Fit Index (NFI) 0.932, and that of Root Mean Square Error of Approximation (RMSEA) 0.063. Thus, the measurement model fitness values were statistically significant.

Table 3 Results of reliability and convergent validity testing

Classification	Variable	Standard loading	Standard error	t	AVE	CR	Cronbach α
Personal influence	PI1	0.778			0.511	0.817	0.711
	PI2	0.646	.072	7.364***			
	PI3	0.694	.065	7.002***			
Information quality	IQ1	0.878			0.637	0.929	0.825
	IQ2	0.682	.067	18.921***			
	IQ3	0.989	.060	14.443***			
Social influence	SI1	0.801			0.625	0.816	0.770
	SI2	0.648	.067	10.898***			
	SI3	0.675	.084	9.893***			
Perceived usefulness	PU1	0.770			0.722	0.766	0.693
	PU2	0.602	.072	7.820***			
	PU3	0.797	.071	7.759***			
Use satisfaction	US1	0.777			0.735	0.765	0.724
	US2	0.687	.071	9.555***			
	US3	0.631	.064	8.814***			

Measurement model fit: χ^2(df) 148.900, χ^2/degree of freedom 2.327, RMR 0.017, GFI 0.942, AGFI 0.871, NFI 0.932, TLI 0.943, CFI 0.920, RMSEA 0.063
** p<0.05, ** p<0.01, *** p<0.001*

Table 4 Correlation Matrix

	PI	IQ	SI	PU	US
Personal influence (PI)	0.511				
Information quality (IQ)	0.595**	0.637			
Social impact (SI)	0.568**	0.536**	0.625		
Perceived usefulness (PU)	0.624**	0.464**	0.540**	0.722	
Use satisfaction (US)	0.582**	0.446**	0.525**	0.741**	0.735

*Note: * p<0.05, ** p<0.01, *** p<0.001 / The square root of AVE is shown in bold letters.*

4.2. Analysis Results of Structural Model

As shown in Table 5, as the suitability of the structural model was analyzed, $\chi 2(p)$ was 134.687(0.000), and $\chi 2$ /degree of freedom was 2.172. The value of GFI was 0.947, that of NFI 0.947, that of AGFI 0.892, and that of RMSEA 0.095. Thus, most values of the measurement model fitness were statistically significant. The value of CFI, which is not affected by the sample but represents the model's explanatory power, was 0.965. The value of TLI, which indicates the explanatory power of the structural model, was 0.949. Thus, it was viewed that the basic model was entirely appropriate.

As hypotheses were examined through the path analysis of the structural equation model, 2 out of 7 hypotheses were rejected, as shown in Table 5. It turned out that perceived usefulness was affected by personal influence on the level of 1.818 ($p<0.05$) and by social influence on the level of 2.698 ($p<0.01$). Thus, perceived usefulness was affected positively (+). It turned out that use satisfaction was affected by personal influence on the level of 1.107 ($p<0.05$) and by information quality on the level of 2.977 ($p<0.01$). Thus, use satisfaction was affected positively (+). As perceived usefulness affected use satisfaction positively (+) on the level of 4.570 ($p<.0001$), the hypothesis was adopted. However, information quality did not affect perceived usefulness, and social impact did not affect use satisfaction significantly. Thus, the related hypothesis was rejected.

Table 5 Results of the Hypothesis Test

	Hypothesis (path)	**Standard loading**	**Standard error**	**β**	**t-value (p)**	**Hypothesis**
H1	Personal influence factors -> Perceived usefulness	0.473	0.260	0.373	1.818*	Adopted
H2	Information quality factors -> Perceived usefulness	0.089	0.125	-0.078	-0.708	Rejected
H3	Social impact factors -> perceived usefulness	0.603	0.224	0.604	2.698**	Adopted
H4	Personal influence factors -> use satisfaction	0.259	0.234	0.213	1.107*	Adopted
H5	Information quality factors -> use satisfaction	0.359	0.121	0.330	2.977**	Adopted
H6	Social impact factors -> use satisfaction	0.053	0.230	-0.055	0.229	Rejected
H7	Perceived usefulness -> use satisfaction	0.902	0.197	0.941	4.570***	Adopted

Structural model fit: $\chi^2(df)$ 134.687, χ^2/degree of freedom 2.172, RMR 0.016, GFI 0.947, AGFI 0.892, NFI 0.939, TLI 0.949, CFI 0.965, RMSEA 0.059
** p<0.05, ** p<0.01, *** p<0.001*

5. CONCLUSION

This study aims to verify factors that most significantly affect perceived usefulness and use satisfaction among personal, social, and information quality of customers who use digital healthcare services and empirically analyze the relations. The following are the analysis results: First, information quality affected perceived usefulness most significantly. In use of service, information quality directly related to service use such as shared information, information reliability, and information availability caused the most significant influence. In order to promote the expansion and continued use of digital healthcare services, information quality need to be improved.

Second, personal influence affected both perceived usefulness and use satisfaction. In using digital healthcare services, users' personal attributes such as self-efficacy and personal innovation directly affected the value of healthcare service use or satisfaction. In order to promote digital healthcare service, therefore, it is necessary to realize personal innovation that induces the direct experience of individuals and self-efficacy perceived from using such service.

Third, it turned out that social impact caused the most significant positive effect on satisfaction with digital healthcare services. These results suggest that healthcare service is helpful for individuals and social networks with service providers, medical centers, and governments. Notably, it is necessary to cooperatively exchange information with communities such as family and friends for health management. In reflection of such characteristics, it is inevitable that the level of satisfaction with service increases when there are social support, value, and capital around users in addition to personal factors.

Despite such implications stated above, this study has the following limitations: First, this study examines perceived usefulness and use satisfaction among users of digital healthcare services in Korea while there are various other independent variables to be considered. Second, this study assumes three primary factors of digital healthcare service: personal influence factors, information quality factors, and social impact factors. However, the future study is expected to examine various other factors such as governmental policy, technical power, and corporate environment considering the growth rate in the digital healthcare area.

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